

The Impact of Digital Economy on the Development of Construction Services in China

Chendi Shao

*School of Economics and Management, China Jiliang University, Hangzhou, China
1085675263@qq.com*

Abstract. As a key measure of economic modernization, service trade plays a crucial role in global economic development, with the digital economy acting as the primary engine of growth and innovation across industries. Accordingly, this paper investigates the impact of the digital economy on China's construction service trade. In particular, through an in-depth and case analysis, it examines the entire process of construction service trade exports and explores how the digital economy is reshaping various stages of the trade. The results reveal that the growth of the digital economy has broadened the scope of China's construction service trade, boosting product value-added and prolonging service cycles, strengthening its global competitiveness. Moreover, it also highlights the successful integration of China's construction service trade with the digital economy, providing valuable insights that can be adapted to other service trade sectors or traditional industries.

Keywords: Digital economy, Digital transformation, Construction trade, Service innovation, Competitive advantage

1. Introduction

In today's world, service trade has become a core hub of the global value chain and an important indicator of a country's economic modernization level. According to statistical data, the total scale of global service trade reached 7.1 trillion US dollars in 2023, accounting for 30% of total global trade volume and contributing nearly half of trade value-added. Among this, the proportion of digital delivery services has surpassed 60%, becoming the fastest-growing and most resilient sector. Service trade is not only a key tool to balance goods trade surplus and optimize trade structure, but also a strategic pivot to enhance industrial added value and foster new productivity. Currently, most existing literature links the "digital economy" with "goods trade" or "traditional service trade," with limited focus on the "construction service trade" sector, which integrates technology and services. Additionally, the widespread use of Building Information Modeling (BIM) and Machine Learning (ML) techniques in Construction Project Management (CPM) reflects that most existing studies are concentrated on data analytics and visualization in the engineering context [1]. This paper explores the current development of China's construction service trade, examining the impact of the digital economy across different stages of the trade process. Besides, it examines how the digital economy drives the internationalization of construction service trade and enhances its global competitiveness. Through literature analysis and case studies, it explores how digital technologies enhance efficiency,

reduce costs, and expand markets in construction service trade, thus strengthening China's global competitiveness and providing insights for policy and industry development.

2. The diversified development of China's construction service exports

2.1. The growth and trends of global construction service trade

International construction service trade involves a range of services that span the entire lifecycle, including design, construction, management, and maintenance, all centered around the production of construction products and associated service processes. These services can be delivered through cross-border provision, establishment of commercial presence, or movement of natural persons. As one of the twelve service trade types defined by the World Trade Organization (WTO), construction service trade has shown a rapid growth trend in recent years. Global construction service exports increased from \$26.84 billion in 2005 to \$1,040.5 billion in 2023, while China's exports rose from \$2.5 billion to \$31.41 billion over the same period, reflecting China's sustained rise and expanding share in the global market. This growth is reflected not only in China's total export volume but also in its rising global market share, as shown by Equation 1.

$$\text{InternationalMarketShare} = (\text{Thecountry'sexports} / \text{Totalworldexports}) \times 100\% \quad (1)$$

Based on Table 1, China's share of global construction service exports increased steadily from 17.4% in 2015 to 27.5% in 2023, reflecting its strengths in technological innovation, industrial chain integration, and cost efficiency, and indicating that China's role in the global construction service market has shifted from a follower to a leader.

Table 1. China's share of global construction service exports (unit: %)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
China's share in the world	17.4	14.4	22.2	22.7	25.2	25.7	28.2	26.7	27.5

2.2. The transformation and innovation of China's construction service export modes

In 2000, China relied mainly on labor cost advantages and personnel deployment to secure low-end construction orders, thereby prompting more diverse export forms. However, the export of China's construction technology standards, together with enhanced industrial chain integration and progress in digital and smart construction, has notably enhanced the competitiveness of Chinese construction services. As a result, export models have kept evolving, steadily developing into a new ecosystem that integrate "diverse models" into "full-chain" approaches. Table 2 outlines four main export models with specific examples, indicating the growing diversity of China's construction trade.

Table 2. Four export models of construction service trade and examples

GATS Mode	Specific Examples	Key Facts	Traceable Source
Mode 1 Cross border Delivery	U.S. airport owners purchase BIM modeling services through a cloud platform	Relies completely on cloud delivery, with no cross-border movement of personnel	ENR Report 2022
Mode 2 Overseas Consumption	Qatari owners hire China Southwest Architectural Design Institute for project design in China	Completes design work on-site in Chengdu	China Construction Southwest Institute official website 2024
Mode 3 Commercial Presence	China Communications Construction Company establishes a subsidiary in Kenya to build the second container terminal at Mombasa Port	Registers a local entity, undertakes the port EPC project	Kenya Business Daily 2023
Mode 4 Natural Person Movement	Chinese engineers participate in the NEOM city tunnel project in Saudi Arabia	Deploys over 120 Chinese experts to provide on-site management services	CSR Report 2023 of China Railway Tunnel Bureau

In addition, China has used its digital strengths to shift from labor-intensive building exports to a high-value “technology+management+consulting” model. In this process, China has also actively provided ESG-compliant services to the world like green consulting and energy-saving assessments. The development of China’s international competitiveness in construction trade services in recent years can be clearly assessed through the Comparative Advantage Index (RCA) that is presented. The formula for calculating this index is shown in Equation 2.

$$RCA_{ij} = \frac{x_{ij} / \sum x_{ij}}{\sum x_{ij} / \sum \sum x_{ij}} \quad (2)$$

The evaluation criteria for competitiveness, as indicated by the RCA index, are delineated as follows: an RCA value of 2.5 or above signifies strong international competitiveness; a value ranging from 1.25 to 2.5 denotes strong competitiveness; and a value between 0.8 and 1.25 suggests moderate competitiveness; and a value below 0.8 indicates weak competitiveness.

Based on Table 3, since 2015, China’s RCA index has consistently remained well above 2.5, highlighting China’s dominance in global construction trade. Fueled by technological progress, digital upgrades, and strong policy backing, China’s construction service exports to regions such as Southeast Asia have surged. This expansion has further solidified China’s dominant stance in the global market.

Table 3. RCA index of China’s construction service trade from 2015 to 2023

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
China Construction Service Easy RCA index	4.01	3.52	5.44	5.15	5.66	4.82	4.54	4.61	5.71

2.3. The digital economy driving global growth and industrial transformation

The rise of the digital economy has fundamentally reshaped patterns of global growth and national competitiveness. By 2023, the global digital economy is projected to reach USD 43.5 trillion, accounting for 46% of global GDP, while exports of digital services are expected to total USD 4.1 trillion, representing about 60% of global service trade. Since 2020, the global economy has been severely affected by the pandemic, yet the intangible nature of service trade has highlighted the comparative advantages of the digital sector [2]. As a result, highly digitalized service trade has been less impacted than traditional goods trade. The digital economy has already generated, and will continue to generate, both direct and indirect positive effects on international trade, and its role is expected to become increasingly significant in the future.

The digital economy has reshaped global trade dynamics, with leading countries like the U.S. and China driving technological innovation and digital infrastructure development. Meanwhile, disparities in digital capabilities remain, with many nations lagging behind. At the same time, the structure of the digital economy has also undergone significant change. Industrial digitalization has replaced digital industrialization as the dominant trend, indicating a shift in digital technologies from being confined to the “digital industry itself” to functioning as “general-purpose technologies that enable transformation across all industries” [3]. In other words, whereas the digital economy previously emphasized the creation of new industries through digital technologies, it now focuses on reshaping existing industries through digital integration. The impact of digital innovation on construction service trade is particularly profound [4]. Basic communication infrastructures such as 5G and fiber optic networks have improved the efficiency of international trade, while advanced technologies including big data, artificial intelligence, intelligent manufacturing, e-commerce profiling, precision marketing, and construction service visualization have enhanced service quality across the entire value chain of construction service trade.

3. The mechanisms of digital technology in transforming the construction service trade

The basic framework of international trade encompasses five key stages: market development, order acquisition, order execution, logistics and customs clearance, and settlement and after-sales service. By opening up new possibilities for service innovation, digital technologies and transformation improve trade efficiency, optimize the structure of international trade in construction services, and reduce both capital and time costs [5,6].

3.1. Market development and order acquisition support

By expanding market boundaries, reducing client acquisition costs, and improving the efficiency of cross-border transaction matching, digital technologies are reshaping market development and order acquisition in construction services [7]. Their application in this phase reshapes both the discovery of overseas opportunities and the acquisition of international orders. In the market development stage, digital tools convert the traditionally slow, costly, and labor-intensive process into a real-time, data-driven task. The route radar, driven by big data, gathers tenders, financing notices, government budgets, and industry forum information from target countries, while natural language processing structures the data for rapid identification of promising regions. Also, BIM cloud platforms provide digital twin project libraries, allowing overseas clients to access project data, cost components, and simulations through VR. This approach extends information matching globally and reduces client acquisition costs by over 60%.

In the order acquisition stage, advanced communication and contracting technologies further streamline the process. The 5G- and low-Earth-orbit-based “Tiandi-1 Network” enables low-latency video meetings and AR presentations, maintaining delays below 50 ms even in remote locations. In addition, cloud-based certification, electronic signatures, and smart contracts streamline protracted offline procedures into rapid, minute-level online processes. AI models assess client credit and risk profiles using transaction histories, thereby improving bid success rates by 15-30%. By automating performance bonds and milestone payments, smart contracts, along with on-chain digital RMB and forward contracts that mitigate bond and currency risks, reduce related costs by about 30%. These technologies establish a “digital flywheel” that integrates opportunity detection, digital showrooms, negotiation, and contract execution, hence enabling orders to progress seamlessly from discovery to conclusion and enhancing overall international trade efficiency [8,9].

3.2. Order execution and logistics management enhancement

In the order execution and logistics management stage, digital technologies streamline construction monitoring and allow real-time, visualized cross-border logistics. By integrating IoT sensors, digital twin platforms, and remote monitoring tools, construction processes can be monitored in real time. Specifically, installed on formwork, reinforcement, and tower cranes, sensors continuously gather over 30 indicators, including concrete strength, crane stress, and dust levels, and relay the data to the digital twin via 5G edge computing every five seconds. Subsequently, engineers at headquarters perform remote inspections using VR headsets, and any threshold exceedance triggers immediate alerts on phones or smart helmets, enabling rapid corrective action. As a result, on-site supervision is reduced by 20%, while travel and labor costs are lowered.

Through digital technologies, cross-border logistics and customs clearance are similarly boosted. Blockchain-enabled single-window systems compress export declaration time from days to hours by allowing electronic customs declarations, bills of lading, and certificates of origin to be uploaded once and shared across multiple parties, reducing demurrage and amendment fees by an average of 25%. An AI risk engine pre-screens HS codes, increasing the likelihood of using “green channels” by 40%. The Beidou+5G logistics tracking platform enables real-time monitoring of prefabricated module temperature, humidity, vibration, and vessel location, automatically alerting for anomalies and reducing claims and disputes by 30%. By combining a digital twin terminal, ship berthing and quay crane operations are simulated, loading plans are dynamically adjusted, and a fully digital closed loop from factory to port, vessel, and overseas construction site is achieved, cutting overall logistics costs by 8 to 12%. Thus, these technologies turn construction monitoring into a remote, data-driven cycle and optimize logistics and customs clearance into traceable, hourly operations, significantly boosting efficiency and risk oversight in international construction service trade.

3.3. Settlement efficiency and after-sales service optimization

In the settlement and after-sales stage, digital technologies play a key role in accelerating cash flow and extending service value in construction service trade. Through the use of digital letters of credit, smart contracts and cross-border electronic payment platforms, traditional settlement cycles lasting 10 to 15 days are greatly shortened. Once shipment data, quality inspection reports, and blockchain bills of lading are verified, payments are triggered automatically, with exchange rates and handling fees locked in smart contracts. This process cuts collection time by about 70% and doubles cash flow turnover, allowing enterprises to pursue additional overseas projects continuously.

By deploying digital twin models, digital technologies elevate after-sales service to a long-term value proposition, enabling remote monitoring and predictive upkeep via IoT sensors, operational logs, and AI algorithms. If a steel component exceeds stress limits, the system instantly dispatches maintenance requests to the closest warehouse and service team, reducing average downtime by 35%. This approach transforms one-time project delivery into continuous technical service exports, maintaining enterprise benefits and strengthening reputation. Overall, digital technology fosters a qualitative leap in construction service trade by improving settlement efficiency, extending service continuity, and boosting overall service quality. The acceleration of digital integration, enablement of dynamic data exchange, and optimization of production, circulation, and service processes are crucial for strengthening industry competitiveness [10].

4. The enhancement of construction service competitiveness

In order to enhance the global competitiveness of Chinese construction services, it is imperative to consolidate the foundation of digital infrastructure. This entails integrating the core components of “network, cloud, data, intelligence, and chain” while coordinating the development and utilization of advanced infrastructures such as 5G, IPv6, and gigabit fiber optic networks, ensuring real-time assessment of their readiness. By establishing a robust digital infrastructure, China can maximize digital dividends and foster innovative business models, such as cross-border payments and digital letters of credit, laying a solid foundation for the digital transformation of construction services.

Equally important is the establishment of a unified global framework for architecture and digital rules. To this end, China can take the lead in developing and promoting the “Unified Framework for Cross-border Digital Delivery of Building Data,” which simultaneously integrates BIM, IoT, and blockchain interfaces. Moreover, establishing international compliance dialogue mechanisms can facilitate the export of Chinese solutions, reduce the costs associated with duplicate certification, and thus enhance global influence and competitiveness. In parallel, the enhancement of the added value of construction service products is a key priority. Through the adoption of BIM, digital twin technologies, and AI-driven operation and maintenance, Chinese construction services can deliver comprehensive, long-term data solutions encompassing the entire lifecycle of “design, construction, and operation.” This approach supports the use of green, low-carbon, and intelligent technologies, while enhancing the premium positioning and international competitiveness of China’s construction services. Besides, the expansion into international markets is essential for fully leveraging China’s advantages [11]. Despite their strong domestic advantage, construction services exert limited impact internationally. The promotion of cross-border infrastructure projects and international cooperation initiatives enables the expansion of demand in relevant countries and regions, fostering the export of Chinese construction services and creating new opportunities for growth in highly competitive, yet previously untapped, markets.

5. Conclusion

With the significant advancement of digitalization, China’s construction service exports have surged, and its global market share has increased substantially. The competitiveness of the industry has grown, with exports evolving from a single, low-level category to a diversified range of high-value products. The share of high-value digital services, like green consulting and smart construction sites, has notably risen, extending to the full lifecycle of construction services and after-sales maintenance. However, challenges remain, like the limited digitalization of small and medium-sized enterprises, difficulties in hiring interdisciplinary talent, and the absence of unified cross-border data

standards. These constraints continue to hamper the optimization of construction service trade, driving up both costs and complexity. Future research should focus on strategies to enhance digital adoption in the construction industry, explore effective models for talent development in construction and digital technologies, and promote the establishment of global standards for cross-border data exchange. In addition, further exploration of the integration of emerging technologies such as AI, blockchain, and IoT in construction service trade, alongside innovative business models for long-term value creation, could further enhance the industry's global competitiveness.

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